A.D. 1864, *20th October.* N° 2598.

Brewing and Distilling, &c.

(*This Invention received Provisional Protection only.*)

PROVISIONAL SPECIFICATION left by William Littell Tizard at the Office of the Commissioners of Patents, with his Petition, on the 20th October 1864.

I, WILLIAM LITTELL TIZARD, of Birmingham, in the County of Warwick, Brewers' Engineer, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN BREWING AND DISTILLING, AND IN APPARATUS EMPLOYED THEREIN, PARTS OF WHICH ARE APPLICABLE TO THE SEPARATION OF LIQUIDS FROM SOLIDS," to be as follows:—

The chief object of the improvements in which my present Invention consists is to render the Bavarian process of vinous fermentation commonly practicable by, and otherwise suited to the requirements of brewers and distillers who have hitherto been unable to practise it, whether in consequence of their breweries or distilleries being situated in countries the climates of which do not present naturally (or at least not at any fixed and regularly recurring season or seasons, or, as a rule, for more than very short periods at a time) those conditions under which alone vinous fermentation can be successfully conducted on the principles on which the Bavarian practice is founded, and with the important advantages which attend that practice, or on account of some of the other conditions which have hitherto hampered the practice of Bavarian process, not being in accordance with the special necessities of their trade, or from both these reasons combined. What is here spoken of as the Bavarian process of vinous fermentation is that process hitherto confined to the best brewers of Bavaria, the advantages and chief features of which are

stated by Dr. Liebig in his work on "Chemistry in its Applications to Agriculture and Physiology."

The essential characteristics of the Bavarian system consist in the fermentation being conducted at a temperature "never allowed to rise above from 45° to 50° Fahrenheit," and in the azotised constituents of the wort being oxydised, not at the expense of any of the sugar of the wort, but solely by the oxygen of the atmosphere, the low temperature being essential not only to prevent the azotised constituents of the wort having the power to seize oxygen from the sugar of the wort, and thereby to render so much of the sugar unavailable for conversion into alcohol, but likewise to enable the wort to be freely exposed to the air in order that its azotised constituents may be oxydised by atmospheric oxygen without the alcohol generated by the fermentation being oxydised also. Although to facilitate this oxydisement by the atmosphere of the azotised constituents of his wort the Bavarian brewer uses very shallow gyles, which expose direct contact with the atmosphere a very large surface of wort, he nevertheless finds the process of oxydisement so slow as to extend over "from three to six weeks." The Bavarian system, therefore, as followed hitherto is practicable only in countries in which a temperature not higher than from 45° to 50° uniform for periods of from three to six weeks is of frequent occurrence. In Great Britain such a temperature continuous for so long a period perhaps never occurs, and certainly could not be relied on to recur frequently or at regular intervals and at fixed seasons, and of so many other countries is this equally true, that the Bavarian process has hitherto been confined solely to Bavaria, while even in Bavaria it has been practicable only in the winter. By the method of procedure and the apparatus and appliances for carrying it out, which constitute the chief part of my present Invention, I render the great advantages which result from the management of vinous fermentation on the principles on which the Bavarian practice is founded available to brewers, distillers, and wine makers who do not enjoy advantages of climate naturally suited to the Bavarian process as conducted hitherto, and whom it would not suit to have to allow "from three to six weeks" for the process of fermentation, or to be able to work only during a part of the year.

The first part of my Invention relates to cooling atmospheric air below the average mean temperature of a British climate, say 52° F., and in applying it, among other cooling purposes, to the cooling of water, worts, fermenting, and store rooms, and to oxydising worts during their fermentation, thereby enabling the brewer to decarbonize his worts more expeditiously and at temperatures from 15° to 25° F. lower than heretofore, whereby a lighter, softer,

finer flavored, better preserving, and a more spirituous article is produced than by any other means extant.

The second part of my Invention relates to the construction of cooling apparatus by which to correct the varying temperature of the atmosphere and to meet the requirements of the operator, whether brewer, distiller, or wine maker. The apparatus consists of a strong iron cylinder lined with coils of copper tubing and containing a hollow rouser. Its exterior is fitted with a pressure guage, a thermometer, and air pump; this is called the high-pressure cylinder. There is also another cylinder of similar dimensions, but not necessarily so strong, which is furnished exteriorly with a thermometer and pressure guage; this is called the low-pressure cylinder. These two cylinders are connected by means of a pipe and cock and a differential self-acting valve apparatus which regulates the pressure of air in the low-pressure cylinder. On working the air pump, the high-pressure cylinder is filled with air until the pressure guage indicates from 150 to 200 lbs.; during and at the termination of this operation considerable heat is developed by such concentration, in short the latent heat of the air becomes sensible to the thermometer, which now indicates, for example, 75° degrees Far. Cold or well water is now passed through the pipes and rouser, and the latter put in motion until the air is reduced in temperature to that of the water, or nearly so, say, to 53°, when a little of this cool air is turned into the low-pressure cylinder and cut off by the self-acting valves at any degree of tension required, which usually ranges from one to three pounds, and there presents itself ready for use at a further reduced heat of some 10° or 15°, which reduction is owing to the dilatation of both the air and its habitant caloric on being released from high to low pressure. Pipes and cocks connect the low-pressure cylinder to the fermenting and store rooms, fermenting vessels, refrigerating or any apparatus, place, or purpose in which air at about 38° or 40° may from time to time be required. Where air-cooling apparatus is required on a small scale or of a less costly nature, I dispense with the higher-pressure cylinder and substitute therefor a tubular receptacle (made on the principle of a common refrigerator) and lay it in a trough of running well water and connect its exit end with the low-pressure cylinder before described.

The third part of my Invention relates to a novel cooling apparatus or refrigerator which is specially adapted to the expeditous cooling of worts with cold air and water together, by which alone the extraordinary low pitching temperature of 45° here required is attainable. To this end I construct a series of cellular of plates of tinned copper tubes, of a somewhat oval form in section, having holes at their ends for the transmission of water and air

through them. These hollow plates are placed upright, and about one inch apart, with their tubular petitions horizontally, the ends of which are closed by movable doors, each of which is lined with vulcanized rubber to make the instrument water and air-tight. One of the doors contains hollow passages through which the cooling media pass, and which communicate with the interior of the top and bottom of each plate alternately. The spaces between the plates are wort channels. These, when in use, are partially filled with movable petitions, whereby the wort spaces are reduced to from one inch to $\frac{1}{16}$ of an inch wide. These petitions are taken out separately when the wort channels of the instrument are scrubbed out. The hot wort enters the refrigerator between the highest plate and the first petition and descends beneath the lowest edge of the latter, and then rises between the narrow space formed by its other side and the next plate, over the top of which the wort passes, when it descends as before until it is cooled sufficiently for the operator's purpose, say, to from 44 to 46°. In the meantime the air issues from the low-pressure cylinder at a tension of less than eight ounces per square inch, and is charged with a small stream of well water which enters the air pipe before it reaches the refrigerator, through which both fluids flow together in an opposite direction to that of the one wide and thin sheet of wort. The power of the instrument is enlarged by withdrawing the cooling media by means of a rotary fan placed on its exit pipe, which increases the dilatation and speed of the moistened air, and consequently its cooling power.

It is a part of this Invention to enclose the fermenting room, or each fermenting vessel, separately by means of a double casing or either brick or wood work, and to enter the chambers so formed through two doors to prevent an exchange of air at such times as they may be opened for the inspection of the gyles. A small valve-like opening is made in the floor or stage for the occasional descent of the expelled gases, and a similar opening is made in the roof or ceiling for the escape of the warmest air. Under ordinary circumstances the atmosphere (besides either checking or stimulating the process) vaporises and absorbs the most volatile principles of a fermenting wort as much in proportion to its dryness as to its temperature or barometrical condition. Such influences are here precluded by moistening the cooled air by a jet of well water before it enters the fermenting chambers, which adds to its cooling power. Thus an artificial climate of about 40°, and uniformly cool, always fills the fermenting room and envelopes the fermenting vessels, to the exclusion of external influences, which provisions harmonize with the principle on which the new system is founded.

Part of my Invention consists in oxydising the azotised ingredients of worts

or wash outside the formenting vessel. I enclose an ordinary fermenting tun and add a perforated tinned copper dish or colander, which is placed a few feet above the surface of the fermenting fluid, and I occasionally pump up into it about one-tenth of the gyle, which falls in small streams through the cold atmosphere, with which the chamber enclosing the tun is always charged, on to the surface of the gyle. Thus the carbonic acid gas, that great obstructive in fermentation, especially at low temperatures, is sifted out of the wort and the yeast absorbs only as much oxygen as it can appropriate within reasonable time, while the temperature of the gyle is kept down to any point ranging from 44° to 50° by passing a blast of air and water through attemperators immersed in the wort or wash.

Part of my Invention consists in placing a perforated coil of tubing a few inches above the bottom of a fermenting vessel and injecting through it cooled, but dry air, from the low pressure cylinder. The modus operandi is as follows:—Eight or ten hours after the wort is pitched or set to ferment at the requisite temperature, say 45°, and with the necessary quantity of yeast, which is from one to three ounces per barrel (instead of as many pounds, as heretofore) the cold-air cock is turned on, when the air, by its inherent tension, passes through the perforated pipe and, in innumerable broken streams or globules, drives the carbonic acid gas out of the gyle and occupies its place; a few minutes injection will raise the yeasty fob some ten or twelve inches high, when the cock is turned off; the frothy head breaks and disappears in the course of a few minutes. The injection of air, and consequent ejection of carbonic acid gas, is resumed every five or six hours, and continued periodically until the saccharometer shows that the attenuation of the liquor is complete, which it is at from 4 to 6 lbs. I employ meters to ascertain and regulate the quantity of air admitted into the gyles. In some cases I introduce my cold air into union or cleansing casks by carrying an air pipe to near the bottom of the cask, and to distribute the air I use a perforated spreader in which the bottom of the air pipe terminates. This introduction of the air not only oxygenates the beer or ale, but assists in driving off the yeast, which rises to the top of the cask and enters a yeast trough.

The two chief products of fermentation consist of a vinous liquor and yeast. With a view to their economy I subject the latter to a speedy and uninterrupted separation by passing it through a a filter which is constructed of four metallic cylinders of unequal diameters placed upright and concentrically one inside the other and about 1½ inch apart. The outer and inner cylinders, videlicit, the largest and the smallest, are made of brass or iron, and the two intermediate cylinders are made of strong woven brass wire or galvanized iron

wire. The smallest of the latter is covered with fustian cloth, and the largest is lined with that or similar material. These four cylinders are placed on a base plate which has a hole in its middle nearly as large as the smallest cylinder. Two ring-like covers enclose the upper ends of the four cylinders and leave the space between the top ends of the two wire cylinders open for the emission of the dried yeast. The base plate and covers are bolted air-tight, with rubber packing, against the ends of the cylinders, forming two enclosed concentric chambers, videlicit, one between the two largest cylinders and the other between the two smallest; these are vacuum or beer channels. An adjusting valve closes or opens the upper aperture between the two wire cylinders by which the quantity or condition of the issuing yeast is regulated.

Connected with the bottom of the base plate are two pumps, one of which injects the fluid yeast into the annular space which is between the cloths of the two wire cylinders, and the other pump exhausts the space which exists on the other side of the latter, and by forming a partial vacuum therein accelerates the exudation of the fluid (beer) through the filtering medium. Thus the separation of fluid and solid is effected by compression inside the cloths and exhaustion on their outsides at the same time, while the dry yeast is forced upwards and falls through the inner cylinder into a tub or other receptacle. To guard against excessive pressure I place a safety valve on the yeast-injection pipe. This filtering apparatus is unlike all others because it is self-disgorging, and being continuous in its action does not require dismemberment to be emptied or cleaned. It is applicable to the separation of liquids from solids generally.

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